Professional development of Latinx engineers on hidden curriculum: An exploratory study

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***Abstract*— This work-in-progress exploratory study presents the perceptions and expressions of Latinx (a gender-neutral term for individuals from Latin American origins) engineers when learning about hidden curriculum (HC). HC represents the lessons learned in educational or working settings that are not necessarily communicated formally. HC is typically used to help administrators and educators to uncover the unseen or unrecognizable issues of a given environment, in an effort to identify inclusive and diverse strategies for success of their students and employees. Developing critical consciousness, or the process of gaining knowledge about the systems and institutionalized structures, developing a sense of agency, and taking action against the forces that perpetuate those structures is important when challenging the HC. In collaboration with the Society of Hispanic Professional Engineers (SHPE), the research team served as both instructors and researchers in a professional development (PD) session to teach a group of 45 Latinx engineering faculty, postdoctoral fellows, and graduate students from across the United States about how to uncover HC and strategies needed to translate these concepts in their instruction and other responsibilities as engineering educators. As a follow-up, a subset of attendees from the original PD, completed a mixed-method survey about HC. Using the frameworks of HC, engineering identity, and critical literacy, the research group analyzed the written qualitative responses. Results suggested that Latinx faculty had a slight change in their awareness about HC but mainly did not transcend to levels where critical consciousness could be achieved. Also, faculty expressed a disconnect between the culture of engineering at their institutions and their overall sense of belonging and empowerment needed to enact meaningful change.**

Keywords—hidden curriculum, Latinx, engineering, faculty

I. INTRODUCTION

Among the types of curriculum that exists in education, hidden curriculum (HC) is one of the most difficult to study [1]. HC encompasses the implicit [1-7] and recently proposed explicit [8] messages and lessons learned in a classroom or working environment [1-7], both of which occur without aware intent [1-7]. While it has been studied in fields like education, psychology, and medicine, its exploration in engineering is still in its nascent stages [1-4]. In this work-in-progress, we present one of the first iterations of a professional development (PD) session that was offered in the Society of Hispanic Professional Engineers (SHPE) conference to a group of Latinx engineering faculty, postdoctoral fellows, and graduate students around the topic of HC. For the purpose of this work, we expanded upon prior work from Villanueva and colleagues [8] to uncover three primary HC perspectives about engineering, in general, and throughout the professional development session.

II. LITERATURE REVIEW

While there are many HC perspectives, three predominant forms are: functional, liberal, and critical. A *functional perspective* centers its attention to the primary systems and structures of education and what individuals in their role can do to maintain a desired level of social order and stability [8]. In this perspective, individuals (e.g., faculty) view their role as assisting others (e.g., students) in learning the social norms, values, and skills needed to function and contribute to society. Thus, individuals under this perspective do not question the status quo but rather support it through their actions and perspectives [8]. *Liberal perspectives* looks deeper into the appearance of "normality" in these systems and structures of education and explores the role of its actors (e.g., students, educators, staff, administrators) in reproducing this system (e.g., school rules, student and faculty codes, relationships between students and faculty) [8]. Liberal perspectives represents a heightened awareness of HC and an intention by an individual to take action over the perceived norm. *Critical perspectives* of HC takes liberal perspectives a step further to explore the larger systemic structures (e.g., government) and systems of power (e.g., predominant societies) and how its ongoing reproduction influences the educational structures and norms that re-enact social injustices throughout its individuals [8]. Earlier work from Villanueva and colleagues [8] is beginning to suggest that between engineering students and faculty, faculty have the most split in HC perspectives (50% functional and 50% critical) compared to students (57% liberal). This early finding suggests that the context of the faculty (e.g., culture, race, gender) may be important in guiding these perspectives and potentially the actions that they may take around HC in engineering.

To help facilitate understanding of HC, as part of the SHPE Faculty Development Institute initiative, the authors were asked to lead a session to Latinx faculty, postdoctoral fellows, and graduate students around issues of engineering education. Given their expertise in hidden curriculum, critical literacies, and identity, the authors developed a teaching workshop informed by the critical literacies ideas from Luke and Freebody [9], which were used as the foundation for analysis.

Luke and Freebody [9] posit that there are four practices to consider in order for critical information to be decoded. For the first practice, called *coding practices*, individuals must first understand the conventions, patterns, and culture-specific texts or modes of their system by exploring diverse types of communications and genres. The second practice, called *text-meaning practices*, helps individuals construct meanings of the ideas presented. The third practice, *pragmatic practice* allows individuals to explore the contexts in which terms and content are used and learned in order to discern what to do with that new knowledge. The fourth practice, *critical practice*, involves an individual discovering and learning how to develop tools to become critics and analysts. A combination of multiliteracies, which include not just language (reading and writing) but also other modes of communicating ideas (e.g., audio, visual, spatial, gesture), was used in the workshop to elicit and let participants engage in the practices that would allow them to become critics and analysts.

Engineering identity in this work was contextually-derived from the participant population (Latinx engineering faculty, postdoctoral fellows, and graduate students). Thus, the framework selected for this work was from Revelo [10] who identifies engineering identity development as having critical dimensions in community, *familia*, and role modeling. Stemming originally from Yosso's Community Cultural Wealth theoretical framework [11] and further expanded from Revelo [10], engineering identity of Latinx individuals stem from the notion that individuals, particularly those who are minoritized, are owners of capital rather than being capital-deficient. The six forms of capital that an individual can acquire constitutes "an array of knowledge, skills, abilities and contacts possessed and utilized by communities of color to survive and resist macro and micro-forms of oppression" [11, p. 77]. From Revelo's past work on engineering members of this conference [10], five themes were found important in Latinx engineering identity: (a) developing professional and leadership skills; (b) making an impact in the community; (c) being a role model to prospective and current students; (d) finding engineering role models; and (e) nurturing an engineering *familia* (or family). The latter, in particular, emphasizes the importance that participation and membership to these types of groups have in helping Latinx members become committed to each other's success and treat each other as *familia*. While the engineering identity work was focused on undergraduate students, we posit that this latter theme may help Latinx faculty, postdoctoral fellows, and graduate students recognize similar issues and as a *familia* develop a support network to overcome any negative incidences of HC.

Together, the critical literacy and engineering identity frameworks described here were embedded upon a larger HC framework to develop a uniquely tailored professional development session. The results explained in this work focuses primarily on the components that resulted in a change in HC perspectives and its influence on potential themes stemming from their Latinx engineering identity.

III. METHODOLOGY

A. Positionality

The authors of this work are all Latinx, engineers, and engineering educators and researchers whose involvement in this PD session stems from a commitment to diversity and inclusivity in engineering. All took measures to ensure that their interpretations of the findings minimized bias on their part by analyzing data through the three theoretical frameworks presented, engaging extensively with qualitative research, and continuing to engage in researcher reflexivity [12]; these steps also ensured that validation procedures took place in this work. As Latinxs ourselves, we reflected on how to create a positive conversational space for the participants given that these topics could trigger different emotions. We acknowledge that in order to challenge normative narratives in engineering education and practice, it is necessary to uncover the discourses that influence how individuals interpret context. In creating that conversational space, we also respected participants' decision not to disclose their racial, ethnic or gender attributes.

B. Research Design

All materials were developed to allow participants to respond in free-form to questions posed throughout the PD session and after. Although the follow-up survey had quantitative and qualitative items, the focus of this work was on the qualitative responses. All human research subject procedures were approved by the Institutional Review Board at Utah State University.

C. Research Questions

The research questions in this study were as follows:

1. What primary HC perspectives did Latinx faculty use to describe their experiences with engineering education throughout the professional development sessions activities and surveys?
2. For a multimodal representation (i.e., video) demonstrating representative HC in an engineering classroom, how did participants use critical literacy (if any) to provide advice to the characters in the video they felt a connection to (e.g., *familia*)?

D. Participants

The participants from this study were part of a SHPE-sponsored workshop to help Latinx engineering faculty, postdoctoral fellows, and graduate students to participate in a one-day PD session while they attended the 2017 annual conference. As part of a professional development session, a three-hour workshop entitled, "Using literacy to identify hidden factors that compromise equitable and effective engineering education" was offered to 45 participants during the afternoon. The participants came from a wide range of institutions (e.g., four-year public and private institutions, and community colleges), served different functions at their institutions (e.g., teaching, research, administrative), tracks (e.g., tenure-track, tenured, non-tenure), and roles (e.g., graduate students, faculty, postdoctoral fellows).

We did not ask participants to provide identifying data (e.g., name, age, gender, institution) because we wanted to keep responses anonymous to protect the participants and not interfere in their own narratives. During the session, three mini-presentations, followed by some professional development activities, were weaved throughout the session. Each author had a chance to speak about their framework and a paper handout including three open-ended questions were

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provided. The handout asked participants about what they had just learned and were asked to reflect upon their existing roles in engineering. At the end of the PD session, participants were invited to participate on a larger survey asking more details about HC and about what advice they would provide to characters in the video if they were in the same situation as the one presented.

E. Overview of Professional Development Content

The PD activities primarily consisted of an in-situ phone-based poll asking participants about their perspectives in engineering. During the HC session, a 7.5-minute video (see Table 1) related to a case study around issues of inclusivity in the engineering classroom was presented to the group. They were asked to provide their feedback in the session and expand upon it more on a follow-up survey.

TABLE I. OVERVIEW OF HC VIDEO CONTENT

	Description
Intro	A White full professor (Dr. Brown) and a Latina assistant professor (Dr. Garcia) are preparing for an engineering class they both teach separate sections.
Dr. Brown's class	Two students: Luis (a Latino male student) and Shane (a White male student) sit adjacent to each other in Dr. Brown's class as he teaches Structural Analysis of Buildings. He mentions the use of buildings using steel-reinforced concrete that is used in Latin American countries. Luis raises his hand and mentions that this is very common in his home country of Venezuela and his father (a construction worker) mentioned those designs were made by Oscar Marty, from Puerto Rico. Dr. Brown nods that he heard the student and continues the lesson. Shane then raises his hand and talks about his experience in Engineers Without Borders. Dr. Brown engages with the student and asks for more details. At the conclusion of class, Dr. Brown asks to speak with Luis as students exit. He thanks Luis for the comment about Oscar Marty, but reminds him that construction and engineering are different. He explains that engineering is about rigorous analysis and design while construction follows the direction of an engineer and emphasizes to Luis that his intention was to clarify so that other students in the class don't lose respect for him.
Dr. Garcia's class	Dr. Garcia enters the class and asks how her students are doing. They respond and she prefaces her lesson on Structural Analysis of Buildings by mentioning it is Hispanic Heritage Month and she wants to talk about the contributions Oscar Marty made to the field of engineering. As she explains who Oscar Marty is, Brian (a White male student) raises his hand and asks if this material will be on the exam. Dr. Garcia responds by stating the exam will focus more on the equations as Dr. Brown suggested. She then continues her lesson. Later, as Dr. Garcia concludes her class, Brian raises his hand and asks to speak with her. Brian goes to the front of the classroom and tells her that he is concerned about the lesson. He acknowledges that she is a new instructor and mentions that his other engineering professors never taught material that would not be included on the exam. He then states that he is not paying tuition to learn about material not covered on the exam like Oscar Marty. Dr. Garcia mentions the importance of discussing the contributions of diverse people in engineering. He does not engage with her on the subject and instead reconfirms what will be on the exam once more. Brian then mentions his uncle who is an engineer who reinforced the idea of knowing the fundamentals of engineering and that if he did not know them he might as well be a technologist.

At the end of each talk, we asked some questions related to their perceptions of engineering and their expectations, about critical literacy (CL) and engineering identity (EI) as summarized in Table 2. For CL and EI, we collected 33 responses and 28 responses, respectively. For the HC follow-up survey, 19 participants responded. Due to our lack of access to participants before and after the workshop, we could not collect demographic information although the majority of participants were male. For the surveys, we allowed participants to choose if they wanted to include demographic information or not to protect their identities and narratives.

TABLE II. SELECT FOLLOW-UP QUESTIONS FOR THE ACTIVITIES

	Select Questions:
HC	Q1. What expectations do you think are placed on engineering students (if you are a student) or faculty (if you are a faculty) at your university? Q2. Where or who do you think those expectations come from? Q3. Do you feel that meeting these expectations can be emotionally exhausting? Why and why not? Q4. After watching the video, which character did you identify with the most? What advice would you offer to them?
EI	Q5. How do you think these dimensions (engineering identity) of engineering represent your own view of engineering? Q6. How do you think these dimensions (engineering identity) represent how you personally identify as an engineer?
CL	Q7. Briefly describe what equity in engineering means to you?

F. Coding Procedure and Analysis

Responses from participants were primarily analyzed through inductive coding from codebooks generated from each of the authors [8, 10, 13], although there was openness to emerging themes. For the character identification question, frequency counts were calculated in the form of a percentage. For changes in HC perspectives, frequency counts in the form of percentages were also calculated. All codes were discussed amongst the authors until full consensus was achieved.

IV. RESULTS & DISCUSSION

Participant responses in the surveys were coded by type of predominant HC perspective and literacy practice used. As shown in Table 3, for questions 1-3 (Table 2), participants' HC perspectives (functional-F; liberal- L; critical- C) changed:

TABLE III. PERCENTAGES OF HC PERSPECTIVES FROM FACULTY IN THE FOLLOW-UP SURVEY (QUESTIONS 1-3 IN TABLE II)

Question *(Description)*	**F**	**L**	**C**
Q1 *(expectations on faculty)*	78%	11%	11%
Q2 *(origins of expectations)*	75%	17%	8%
Q3 *(emotional exhaustion of expectations)*	63%	9%	28%

Among the primary themes found were : (a) professional expectations in engineering (mainly in Q1 and Q2); (b) types of stresses in meeting professional expectations in engineering (mainly in Q3) and (c) views of stress for their engineering students (mainly in Q3). For professional expectations, participants mentioned the demands of their role in academia such as teaching, research, and service. These results paralleled to what has been found in prior research [7,8]. One emerging theme found was how stresses were described by participants when meeting these expectations. Faculty appeared to be disjointed in their beliefs of the types of stresses present in meeting the professional expectations in engineering (a disjoint in their functional perspectives):

… we have a lot going on outside of school (Work, Family, etc) which we devote time to…it often times feels as though if you focus on anything besides school for a moment, you fall behind and have a rough time bouncing back. (Participant 8, Demographics Not Disclosed)

Having small tolerance for failure is emotionally and physically exhausting. Not everything goes according to plan in the real world, yet it is an expectation that is "felt" across the engineering campus. (Participant 13, Demographics Not Disclosed)

Specifically, one faculty member expressed concern that their isolation as one of the only Latinx faculty members at their institution and their town caused stresses related to their work-life balance and their self-expectations of successes and failure in the profession:

I am exhausted right now writing this!...There's so much service. I am physically and emotionally exhausted. I don't understand how others keep up...I don't have family or close friends to support me at my institution, so it feels exhausting to do this all by myself. (Participant 6, Assistant Professor, Male, Mexican/Salvadorean American)

It was interesting that emotionality and feelings were included in some of participants' responses to the stressors of the profession. This may suggest an emotional role to critical perspectives of HC, an observation that may warrant additional research. Also, faculty had differing views of the types of stresses that engineering education can play on their students:

...so say a student is struggling in classes and aren't meeting those expectations. They will be labeled a poor student, when really they are struggling because; Material is poorly taught, work, extracurricular activities, family, and other life issues. Which is taking away their time to focus. (Participant 15, Demographics Not Disclosed)

I believe most students have the ability [to succeed], however most students compare their performance to peers. At times when the bar is set low, students may not feel pressure to achieve high standards, and when the bar is set high, students feel pressure to achieve higher standards than their peers. (Participant 2, Female, Black, Assistant Professor, Ethnicity not Disclosed)

I believe that students yearn to be given knowledge and tools that will help them succeed, and improve the lives of their fellow citizens by applying that knowledge and those tools. It is eustress, positive stress, not emotionally exhausting. (Participant 16, White, Male, Dean of Engineering, Ethnicity not Disclosed)

The findings around stresses for these Latinx engineers are unique and warrants further exploration into what ways these HC perspectives may differ compared to other non-Latinx engineering populations.

When participants were asked to indicate which character they identified with and what advice they would offer (Q4), 53% of the participants identified with the Latinx characters (Dr. Garcia and Luis- minoritized Latinx faculty and undergraduate student) and 47% percent identified with the White male characters (Dr. Brown, Shane, and Brian- majority White faculty and undergraduate students). Most of the advices provided to the characters centered on the need to persist and help students connect their classroom content to real world issues in engineering. Yet, none of them achieved a critical status as no advice was offered to the characters on how to challenge the status quo or what actionable items they can do. Literature suggests that for individuals to achieve critical consciousness, they must first learn to navigate and break the codes of their surrounding systems and structures [8, 10, 13].

For questions 5 and 6, participants were asked how the dimensions of engineering identity represented their understanding of engineering and their own identification with the field. The framework was first covered during the session and then the participants filled out a written form. Almost all participants agreed that the five dimensions mainly represented their view of engineering and their own engineering identity. However, one theme was identified as disconnected to their existing realities in engineering: *familia*. Latinx faculty recognized a lack of sense of belonging within the larger "engineering family" at their institutions, as has been suggested in other literature, where isolation is an issue for faculty of color [9, 14]:

... I feel that belonging to a "familia" as a faculty has been extremely difficult. (Participant 19, self-identified as Hispanic, Latinx, and/or Chicana/o)

I do not see myself as part of an engineering familia. I am in a department/culture with "islands" of professors and students who are not thinking as a cohesive group. (Participant 20, self-identified as Hispanic)

The "committed to community" and "role model" represent a lot how I see myself as an engineer. The "part of an engineering familia" not so much…I see less and less people of my heritage doing what I am achieving…usually I'm the only Hispanic in national panels. (Participant 21, self-identified as Hispanic)

For question 7, participants were asked how they viewed equity in engineering education. Most responses focused on recognizing student's individual needs in the classroom and providing adequate and accessible resources to students. However, a small subset of faculty viewed equity as offering the same level of education to all their students (e.g., normalization).

It is trying to have all students to the same level such as they learn similarly. (Participant 18, Demographics Not Disclosed)

No faculty appeared to know how to allocate resources or critically address how equity in engineering education can be achieved. This parallels work from Luke and Freebody [9] where codebreaking is an important first step to engaging in critical literacy and being able to question the dynamics of knowledge and power in their surrounding environments. Moreover, critical literacies, the distribution of knowledge, and how we read the world around us [15] can impact how individuals position themselves in relation to the power structures that created that HC in the first place. This, may in turn, influence how they become aware about HC and learn how to break the code when navigating around this issue at their institutions [7,8]. More studies are needed to this end.

V. CONCLUSION & IMPLICATIONS

The findings suggest that while Latinx participants from the PD session recognized some HC in engineering, it was not enough to create an "engineering *familia*" nor were they aware about how to critically help themselves and students to navigate the HC at their institutions. While critical literacies can be used as a tool to uncover HC and promote the engineering *familia*, more studies are necessary to investigate its effect on shifting engineering discourses. One unique finding in this study was the divergent ideas of the role that stress has on engineering students in general. While this study is early and limited to a small number of faculty, the findings presented here can help shed a unique insight into the challenges Latinx engineering faculty, postdoctoral fellows, and graduate students experience in academia.

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